REMARKS

In the specification, paragraph 0015 has been amended to more clearly define the meaning of the expression "weight average" in conformity with its ordinary meaning.

Claims 1, 3 and 15 have been amended to overcome the rejection under 35 U.S.C. §112, second paragraph, based on indefiniteness. Specifically, the claims have been amended to clarify that the weight average of the ratios of surface area of one of the flat faces of the particle to the thickness of the particle is at least 100 (claim 1) or at least 200 (claims 3 and 15).

New claim 23 has been added. Accordingly, claims 1-23 are pending in the application.

The Invention

In accordance with one aspect of the invention, it has been discovered that, contrary to the teachings of the prior art, it is not necessary to use a rounded filler in an electrical component encapsulation, overmolding and/or underfilling resin composition. Prior to Applicants' discovery, it was believed that rounded fillers were needed "in order to reduce or minimize risks of damage at semiconductor components." See for example column 6, lines 10-13 of the applied Kaminaga et al. patent. It would be most desirable to eliminate the use of fillers entirely for this particular application. However, fillers are necessary in order to match the coefficient of thermal expansion of the encapsulating, underfilling and/or overmolding material to the electrical component. When selecting an appropriate filler for this particular application, it is necessary to consider, in addition to the effect on coefficient of thermal expansion, the effect that the filler will have on viscosity. As stated in the specification (paragraph 0002) "the polymeric material must have a relatively low viscosity (e.g., typically less than 200 poise)," in order to allow "the polymeric material to flow around and completely encapsulate the components without damaging fragile wiring and interconnections frequently used in electronic devices." Rounded fillers tend to raise viscosity to a lesser extent than irregularly shaped fillers. For example, a 70 to 90 weight percent loading of inorganic filler material, as taught and claimed in the Kaminaga et al. patent, would have a much lower viscosity than a 70 to 90 percent loading of fillers having a platelet structure. A higher

viscosity would be expected to cause damage to the electrical device during the encapsulation, overmolding and/or underfilling process. As stated in the specification, (paragraph 0009), Applicants have surprisingly discovered that "filler particles having a platelet structure and dimensions in the nanoscale range of from about 1 to about 700 nm may be employed at much lower levels than conventional particulate fillers to achieve a desired coefficient of thermal expansion." The lower levels of filler material facilitate preparation of encapsulating, overmolding and/or underfilling materials that have a lower viscosity during the early stages of the molding process, thereby achieving the desired coefficient of thermal expansion with a lower filler loading and reduced potential for destruction of the electronic component due to the lower viscosity and lower shear forces exerted on various fragile features of the electrical component.

In accordance with another aspect of the invention, it has been discovered that thermoplastic polymer materials may be used in an injection molding process to encapsulate, overmold and/or underfill electronic components. As is evident from the applied Kaminaga et al. patent, resin compositions for overmolding, encapsulating and/or underfilling electrical devices have been limited to thermosettable resins, and in particular epoxy resins. The prior art does not teach the use of thermoplastic resins for this particular application. As stated in U.S. Patent No. 6,099,783 (cited by Applicants), electronic devices are typically encapsulated in a protective thermoset body from which a number of leads extend to allow electrical contact and interconnection between the encapsulated semiconductor device and a printed circuit board (column 3, lines 5-10). It is believed that the absence of any teaching or suggestion in the prior art for utilizing a thermoplastic material (rather than a thermosettable material for encapsulation, overmolding and/or underfilling of electronic components) is due to the fact that suitable thermoplastic compositions capable of achieving the appropriate coefficient of thermal expansion and desired viscosity have not been available. Applicants have discovered that desirable coefficient of thermal expansion and viscosity characteristics may be achieved for thermoplastic materials by utilizing either hollow inorganic spheres and/or platelet filler materials.

Prior Art Rejections

Claims 1-10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. (U.S. Patent No. 6,257,215) in view of Shin et al. (U.S. Patent No. 6,593,404). As stated by the Examiner, the Kaminaga et al. patent discloses a semiconductor device comprising an electrical component 10 encapsulated, overmolded and/or underfilled with a polymeric composite including a synthetic resin matrix 7 and inorganic filler particles substantially uniformly distributed in the matrix. As admitted by the Examiner, the Kaminaga et al. patent fails to disclose particles having a platelet structure. As stated by the Examiner, the Shin et al. patent discloses thermoplastic resins which may or may not contain inorganic fillers such as mica, talc, zeolite and montmorillonite . . . " From these disclosures, the Examiner has concluded that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Kaminaga et al. to reduce the occurrence of stress cracking for the semiconductor package."

It is respectfully submitted that those having ordinary skill in the art would not be motivated to utilize the Shin et al. material containing montmorillonite filler, since this would be contradictory to the teachings of the Kaminaga et al. patent. In particular, the Kaminaga et al. patent teaches that rounded fillers should be used "to reduce or minimize risks of damage at semiconductor components." Further, the materials of the Shin et al patent comprise a thermoplastic resin matrix, whereas the Kaminaga et al. patent only discloses the use of transfer-molded epoxy resins (i.e., a thermosettable material).

Further, there is an absence of motivation for utilizing the Shin et al. material in the device of Kaminaga et al. for the purpose of reducing "the occurrence of stress cracking for the semiconductor package." Applicants are not aware of any stress cracking problems associated with the Kaminaga et al. device. To the contrary, the Kaminaga et al. patent expressly discloses that the resin-sealed electronic apparatus described therein makes it possible "to provide at low production costs the intended high-reliability electronic apparatus that is strong against bending stress forces." See column 7, lines 60-67 of the Kaminaga et al. patent. Moreover, the Kaminaga et al. patent does not mention any problem with "stress cracking." Finally, the Shin et al. patent discloses that fillers are optional, and are not related to the alleged stress cracking resistance improvement achieved by the materials of Shin et al.

To the contrary, the alleged improvement in stress cracking resistance is achieved by utilizing a combination of phosphate ester and a mixture of alkyl substituted monophosphate esters. This improvement is not relevant to resin compositions used for underfilling, overcladding, and/or encapsulating electronic components.

In view of the absence of any real motivation for utilizing the materials of the Shin et al. patent, especially utilizing those materials with a filler having a platelet structure, and in view of the express teachings of the Kaminaga et al. patent that fillers for this application should be rounded to reduce or minimize risks of damage at semiconductor components, it can hardly be said that that the invention is obvious based on the Kaminaga et al. patent in view of the Shin et al. patent. One having ordinary skill in the art would expect that use of a filler having a platelet structure would be unsuitable for encapsulation of electronic components due to an unacceptably high viscosity. This would in fact be the case if the platelet fillers were used at the same loading levels as taught in the Kaminaga et al. patent. However, Applicants have very surprisingly discovered that it is not necessary to utilize the high loadings as taught by the Kaminaga et al. patent in order to achieve the desired coefficient of thermal expansion. There is nothing in the prior art that would lead those having ordinary skill in the art to this surprising and beneficial discovery.

Accordingly, claims 1-10 are patentable over the combination of Kaminaga et al. in view of Shin et al.

Claims 21 and 22 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. (U.S. Patent No. 6,257,215) in view of Shin et al. (U.S. Patent No. 6,593,404) and further in view of Yu et al. (U.S. Patent No. 5,153,657). The Examiner has concluded that it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Kaminaga et al. and Shin et al. "to improve an efficiency and the reliability of the package" by utilizing the glass spheres disclosed by the Yu et al. patent. Applicants are not aware of any problem associated with efficiency and/or reliability of the package described by Kaminaga et al. Further, the Yu et al. patent does not provide any teaching or suggestion that utilization of glass spheres would improve either the efficiency or reliability of the package described by Kaminaga et al. Accordingly, there is not any motivation in the prior art for the claimed invention. The mere fact that the individual

components of the claimed invention exist in the prior art does not establish *prima facie* obviousness. To the contrary, those having ordinary skill in the art would not expect glass spheres to be suitable for use in a resin composition used for underfilling, overmolding or encapsulating an electronic component, since glass spheres are considerably different from the fused silica disclosed in the Kaminaga et al. patent and would not be expected to impart the desired rheological and thermal expansion properties. Bear in mind that efficiency and reliability of the package does not relate in any known way to use of a particulate filler. Fillers are employed for the purpose of adjusting the coefficient of thermal expansion to that of the electronic component. It is not evident from any of the prior art that the required coefficient of thermal expansion and rheological properties could be achieved by utilizing glass spheres in a thermoplastic resin, rather than utilizing fused silica in a thermosettable resin. According, the claimed invention would not be obvious from the teachings of the prior art.

Rejection Under 35 U.S.C. §112

Claims 1-22 have been rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. In particular, the Examiner has stated that the phrase "a weight average ratio of surface area of surface area of one of the faces of each particle to the thickness of each particle being at least 100 and at least 200 . . ." contains subject matter which was not described in the specification in such a way as to enable one having ordinary skill in the art to make and/or use the invention.

Applicants agree that the specification does not clearly describe the meaning of weight average ratio. However, it is respectfully submitted that those having ordinary skill in the art would understand that Applicants meant to define weight average ratio in a manner consistent with the use of weight averages for other properties such as molecular weight and particle size. For example, the expression "weight average molecular weight" is understood to mean the sum of the weight times the molecular weight of each molecule in a collection of molecules divided by the total weight of the molecules in the collection. Similarly, the expression "weight average particle size" is understood in the art to refer to the sum of the product of the weight of each particle times its size divided by the total weight of all particles. Thus, the weight average of any property is understood to refer to the sum of the product of the weight

of each entity times a value characterizing the property divided by the total weight of all entities. Accordingly, weight average ratio refers to the sum of the products of the weight of each particle times its ratio divided by the total weight. The specification has been amended to conform with the generally recognized meaning of a "weight average" property.

Claims 1-12 have also been rejected under 35 U.S.C. §112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, the Examiner has objected to the phrase "a weight average ratio of surface area of surface area of one of the faces of each particle to the thickness of each particle being at least 100 and at least 200."

The specification and claims have been amended to conform with the ordinary usage of a "weight average" property, and to more clearly define the invention.

In view of the above amendments and remarks, it is respectfully submitted that the rejections under 35 U.S.C. 112, first and second paragraphs, have been overcome.

CONCLUSION

In view of the above amendments and remarks, it is respectfully submitted that the application is in condition for allowance and notice of the same is earnestly solicited.

Respectfully submitted,

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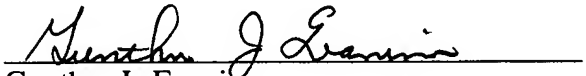

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